

# A Survey Paper on Human Gait Recognition Techniques

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## Abstract

With the advancement in the digital techniques and technology, it is the need of the hour to design and develop some system for automatically recognize the person with the help of biometric system. Biometrics is a technique of authenticate the identity of the person by using unique physiological or behavioral characteristics. Since these properties are unique for individual person so it can be used for recognizing the person. Gait recognition is one of the techniques of person identification in which the gaits of the human being is monitored and analyses for identifying the unknown person. This paper presents a brief review work in various method of gait recognition.

**Keywords:** Gait Recognition, Biometrics, PCA, LVQ, Neural network

## I. INTRODUCTION

One of the important task for identifying the people is recognition. Biometrics is basically physiological or behavioural characteristics of individuals which is unique for individuals. Since these characteristics are unique therefore it can be used for identification purpose.

Vision based human identification has been the area of interest in biometrics research. One of the advantages of this method is that in this type of biometrics system person can be identified from the distance. This type of biometrics is essential for surveillance and monitoring purpose. "Automatic", "Non-Forensic" and "real time" are the characteristics of the biometric identification system. This system works just like the human being work for recognizing the person e.g. one people recognize the other people by face when they meet each other or by listening their voice when they speak to each other[1].

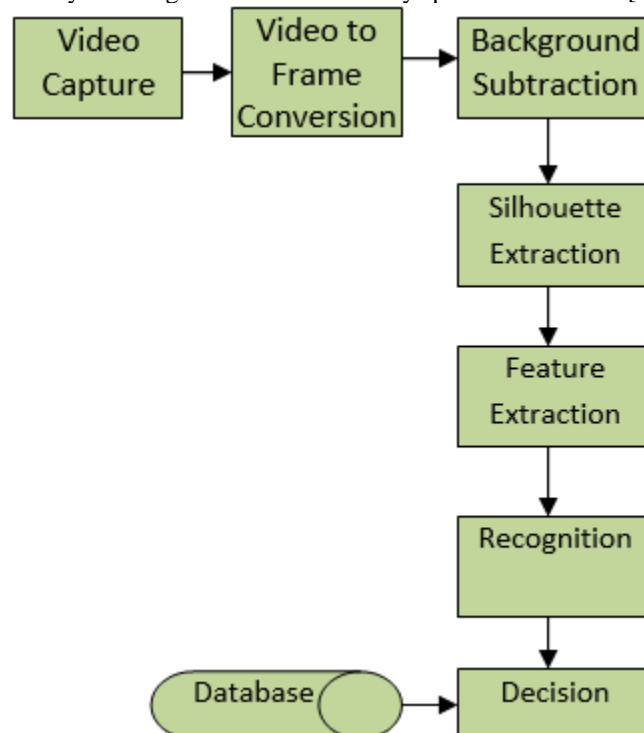


Fig. 1: Biometrics gait Recognition System

A biometric system can be considered as a pattern recognition system which establish the person identification by making a comparison of the binary code of various unique biological or physical characteristics.

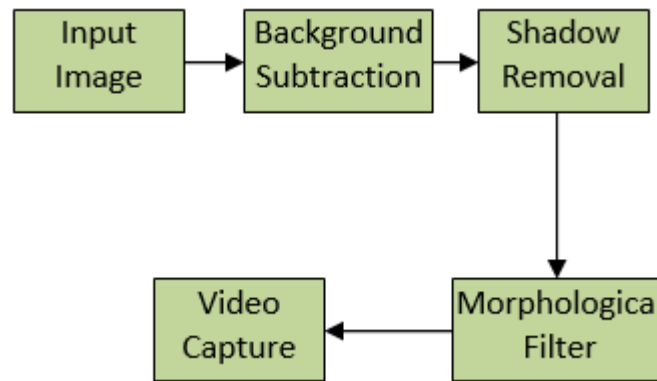


Fig. 2: Silhouette Extraction

For accomplishing this task, a live sample is first of all taken from the video camera. System then apply a complex and specialized algorithm to the sample taken and convert this sample to a binary code. This binary code is the compare with the binary code already stored to judge the identity of the individuals. The template containing the biometrical characteristics are stored in a system. These template are matched with the current sample template to identify the person[2].

## II. LITERATURE SURVEY

In the year 2003, Wang et al. in the paper[3], first time presented an approach of gait recognition task by deriving the binary silhouette of walking person which are later on converted in to a one dimensional normalized distance signal by contour unwrapping procedure which is taken with respect to the centroid position.

In the year 2003 Sundaresan et al. in the paper[4] presented a method to separate the foreground from the background which is very essential steps of gait recognition. In this approach, adaptive filter is used to filter out the foreground. This is accomplished by taking the summation of the signal before the gait cycle measurement with the help of minima of the signal. Since most of the gait cycle detection method suffer from poor accuracy due to having varying walking speed of a single subject along with the poor segmentation of the silhouettes. This confirms the facts that fusion of dynamic as well as static features are better discriminative features and will boost the overall accuracy of the recognition.

In the year 2004 Yam et al. in the paper [5] performed the analysis of bottom-up model based approach for extracting out the most important dynamic gait features for recognizing the people.

In the year 2004, Wang et al. In the paper[6] extended the work of [5] by extracting out not only the dynamic features but also the static features of the gait motion by using model based approach.

In the year 2004, Tanawongsuwan and Bobick

In the paper [7] observe that all the features which are based on the appearance of the silhouettes of walking subjects are speed dependent. They have suggested that some preprocessing steps must be included for adjustment of the features to improve the recognition rate. Actually there exist a relationship between gait features and the varying walking speed which need to be explored extensively for improving the recognition rate.

In the year 2005, Rahmatalla in the paper [8] suggested that gait pattern of the subject is affected by the restricted clothing. Though the static features give good recognition rate in experimental setup nevertheless this method has proved to be impractical in real time gait recognition system. This is due to the fact that static features of the subject depends on the clothing, bags and other factors. These dependencies greatly affect the recognition rate.

In the year 2005, Lynnerup and vedal in the paper [9] proved the usefulness of the gait analysis in forensics. In their experiments they were successfully identified two bank robbers by matching the video footage of surveillance with the actual video of the suspect. This evidence proved very useful to convict both the suspect. They suggested that gait features, anthropometric and body features have a strong resemblance for the suspect and perpetrators. For benchmarking, baseline algorithm has been adopted to perform comparison. They claimed that their algorithm outperforms the baseline algorithm on GTech database.

In the year 2006, Nixon and Carter in the paper[10] proposed various ways of extracting the discriminative features from gait sequence for person identification. One of the most crucial issue in the gait recognition is the extraction of the appropriate features that can capture the discriminative quality of the persons. This is very essential for robustness of the algorithm and for invariant to weather condition.

In the year 2006, Boulgeouris in the paper[11] proposed a gait recognition methodology which was based on the discrete time wavelet(DTW). In this approach they have used the periodicity of the walking for partitioning the gait sequence in cycles. In their approach they have located the frames indices where the sum of the pixel is minimum. These frames represent the half gait cycle. In order to determine the gait cycle, autocorrelation function of the sum of the pixel is used in order to defy the noisy nature of the original function. In the next step of this algorithm, DTW is computed between all cycles of the probes and gallery sequence. Author claimed that the performance of this algorithm is better than the base line algorithm.

In the year 2006, Xu et al. in paper [12] proposed a novel approach of gait recognition task. In this paper, a matrix representation of the gait data have been developed. In this approach, an image matrix is concatenated in to a single dimension vector for applying the PCA (principal component analysis) and LDA (Linear Discriminant analysis).

This is done to reduce the dimensionality of the data for gait recognition which has been the main problem in gait recognition. Small number of samples or feature vector reduce the error to greater extent.

In the year 2007 Ioannidis in the paper[13] developed three new algorithm for extracting the features for recognizing the gait. In two methods, they have used radial integration transform and circular integration transform. Both of these are based on the radon transform. In the third approach they have used weighted Krawtchouk moments. A comparison has been performed on GC database for all the three approaches and the approach based on the Krawtchouk moments proved to be the best followed by radial and then circular integration transform.

In the year 2007, Boulgouris and Chi, in the paper [14] developed an algorithm. In this approach they perform the redon transform on the binary silhouette and obtain the template. LDA, subspace projection is used to get the low dimensional feature vectors having selected radon template coefficients. These selected radon template are then used for gait recognition purpose. They have registered a significant amount of improvement of this algorithm as compared to the baseline algorithm.

In the year 2008, Lu et al. in the paper[15] presented a layer deformable 2D body model for recognition of gait.

The model they proposed has 10 body segment which are represented by 22 different parameters. These parameter represent the size, position and orientation of the body segments. The orientation and position of the limb were estimated with the help of mean shift algorithm which was applied on the manually labelled silhouette.

In the year 2009 Han Su[16] in his paper study the gait recognition system which uses the biometrics technology. This system was designed to identify the person from a distance and at low resolution. In this paper authors have suggested a PCS based method of gait recognition using L<sub>1</sub>-norm maximization and LDA. In this scheme of gait recognition, L<sub>1</sub>-PCa is used for representing the feature and LDA is used to analyse and classify the features. In this method L<sub>1</sub>-PCA is used for finding the projection by maximizing the L<sub>1</sub>-norm. While LDA is used is used for finding the projection direction. Which minimizes the within class variance or maximize the between class variation. L<sub>1</sub>-PCA and LDA not only keep the gait feature but also reduce the dimension of the features. Performance of this approach is tested in gait database. experimental results reveals that this method is very effective gait recognition for low resolution and noisy data. This method is designed for real time application.

In the year 2010, Ning Suo [17] presented a novel approach of identifying the human at a distance using gait recognition. In this method, Non-linear machine learning, principal component analysis(PCA) and k-nearest neighbourhood classifier is used for classification purpose. Principal component analysis is used to reduce the dimension of the features. For this purpose, kernel principal component analysis is used. K-nearest neighbourhood is used here for classifying the features and hence recognizing the person. Experimental results reveals that KPCA and KNN improves the accuracy of the recognition rate. Results obtained in this paper are of satisfactory level.

In the year 2012 Soumia Benbakriti et.al. in his paper[18] presented an algorithm which recognize the gait of the person automatically. This algorithm, recognize the person by the way they walk. In this algorithm first of all the video is converted in to a frames. In each frames background is subtracted to segment out the person from the background. This process extracts the moving silhouettes of the walker. Gait signature is obtained by computing the angle and contour of the silhouette. This silhouette is categorized by computing the three parameters e.g. Computing the perimeter of contour of silhouettes, computing the area of the silhouettes, computing the angle between right and left leg. A dataset is then created using above mentioned method for all the frames. Principal component analysis (PCA) is then applied to reduce the dimensionality of the dataset. Dynamic time warping is applied in this paper to differentiate different gaits of the human. This method is then tested on the CASIA dataset. Experimental results show better efficiency of this method.

In the year 2012, Neda Kordjaz et.al in his paper [19] proposed another method of gait recognition. This method is based on the fact that gait is very essential dynamic feature of the human which can be used for recognition of the person. Recognition of the person using gait feature does not require any co-operation of the person which need to be recognized. Moreover, this method can work with low resolution camera. Recognition of thye person with gait feature can work from the distance and that benefit attract lots of attention for gait based biometric system. In this method LVQNN is used for improving the recognition rate along with the accuracy. In this method first of all, local motion silhouette images(LMSIs) were produced from the silhouette walking frame sequence. PCA (Principal Component Analysis) was performed for producing lower dimension features. These features later on fed to the classifier for classification purpose. CASIA database has been used in this paper for testing purpose. Various results obtained in this method on CASIA dataset reveals its effectiveness. Some previous methods were also compared with this method of gait recognition for showing its efficiency.

In the year 2015, Arora Parul et.al in the paper[20] present a HOG(Histogram of Oriented gradients) based approach for improving the visible results of gait recognition.

HOG is basically spatial-temporal representation of image. This is known as the gradient histogram Gaussian image (GHGI). This is same as the gait energy image but due to the usage of Gaussian function and application of HOG makes it more efficient and noise resistant. In GEI (Gait energy image), average of all silhouettes are taken which preserve the edge information at the boundaries. In this method, Gaussian distribution has been taken for whole gait cycle and then computation of gradient histogram has been performed at all location. This preserve the edge information inside the silhouette. Features are extracted from this GHGI are later on classified using nearest neighbourhood classifier.

### III. CONCLUSION

This paper present an exhaustive literature work in the field of gait recognition which is a growing field for biometrics system. In any gait recognition system, the accurate generation of silhouettes, appropriate feature extraction and appropriate classifier for classifying the features are very crucial. Different approaches have been presented by different authors for the above mentioned three crucial phase of the gait recognition. All the noteworthy contributions have been incorporated in this paper pertaining to the above mentioned three phase. This paper definitely helps those researchers who are currently involved in gait recognition based biometrics system.

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